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PHYSIOLOGIC RACES OF
PUCCINIA GRAMINIS IN THE UNITED STATES IN 1955

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THE PLANT DISEASE REPORTER

PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Horticultural Crops
Research Branch

Plant Industry Station
Beltsville, Maryland

PHYSIOLOGIC RACES OF PUCCINIA GRAMINIS IN THE UNITED STATES IN 1955[1, 2]

D. M. Stewart, R. U. Cotter[3], B. J. Roberts, and E. B. Hayden[4, 5]

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Summary

Race 15B, which is still the most prevalent race of wheat stem rust in the United States, decreased from 63 percent of the isolates in 1953 to 47 percent in 1955. The 17-29 group which will attack such varieties as Selkirk and Bowie increased from 4 percent in 1953 to 20 percent in 1955. Race 56, third in prevalence, decreased slightly since 1953 to 18 percent in 1955. Race 48A, found for the first time in Mexico in 1953, increased in the United States from 4 percent in 1954 to 5 percent in 1955.

From 31 rusted barberry collections, 25 races and biotypes were isolated, 18 of which were isolated only from or near barberry. The ratio is 1 race to every 1.2 collections.

Race 7, which has been the most prevalent race of oat stem rust since 1950, increased from 58 percent of the isolates in 1954 to 68 percent in 1955. Races 2 and 8 each comprised 12 percent. Race 7A decreased in prevalence from 9 percent in 1954 to 5 percent in 1955. Race 6 was identified in a uredial collection from Columbia, Missouri. It is the first time this race has been found independently of barberry in the Upper Mississippi Valley Region. A variant of race 5, designated as 5A, was isolated from a collection of Saia oats adjacent to barberries at Blacksburg, Virginia. This is the first record of a race in the United States that can attack Saia.

Puccinia graminis tritici

In the United States, 28 races and biotypes or subraces of Puccinia graminis tritici were identified among 755 isolates from 574 uredial collections of wheat, barley, and grasses (Table 1). Race 15B comprised 47 percent of the isolates; the 17-29 group 20 percent; race 56, 18 percent; 48A, 5 percent; and races 11, 38, and 59 comprised 2 percent each. Other races were 1, 14, 15, 21, 23, 24, 29, 33, 35, 36, 38-48 group, 44, 81, 118, 122, 125, 139, and 186.

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[1]Cooperative investigations of the United States Department of Agriculture and the Minnesota Agricultural Experiment Station. Published with the approval of the Director, Minnesota Agricultural Experiment Station.

[2]For summaries for the years 1939 through 1942, see 522 and 522A to C in the Bureau of Entomology and Plant Quarantine E-series; for 1943, 1944, 1945-49, and subsequent reports through 1953, see unnumbered publications in the Physiologic Races series; for 1954, see ARS-81-3.

[3]Pathologists, Plant Pest Control Branch, Agricultural Research Service, United States Department of Agriculture.

[4]Agents, Field Crops Research Branch, Agricultural Research Service, United States Department of Agriculture.

[5]E. C. Stakman continued leadership in the search for supplemental differential varieties and assisted in race identification at various times. Acknowledgment for collections is made to Donald G. Fletcher, of the Rust Prevention Association, and to members of the two Branches and of State Experiment Stations.

Although 15B is still the most prevalent race in the United States, it has decreased from the high of 63 percent in 1953 to 47 percent in 1955. The race 17-29 group increased from 4 percent in 1953 to 12 percent in 1954 and 20 percent in 1955 (Figure 1). Race 56, third in prevalence, decreased from 19 percent in 1953 to 12 percent in 1954 and increased to 18 percent in 1955. Race 48A, which was found for the first time in Mexico in 1953, increased in the United States from 4 percent in 1954 to 5 percent in 1955. The race 49-139 group comprised 1 percent of the isolates in 1953, but only 2 and 1 isolates were found in 1954 and 1955, respectively.

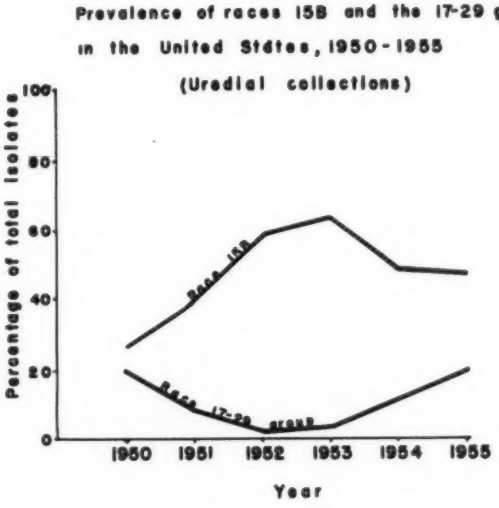

FIGURE 1.

Race 15B was widely distributed except west of the Rocky Mountains, where no collections of this race were identified in 1955. It has not yet been found in California.

Race 15, which is more virulent on some varieties than some biotypes of 15B, was isolated once each from North Dakota and Wisconsin. The isolate from North Dakota came from a collection of durum wheat, R.L. 3207, at Fargo.

The 17-29 group (mostly 29), which will attack some of the newer varieties such as Selkirk and Bowie, was very prevalent in Mexico and widely distributed in 21 States of the United States. It was common in the southeastern states from Florida northward to Pennsylvania and North Dakota, and westward to Idaho. It was fairly prevalent in Texas, Missouri, Minnesota, and North Dakota but was found only 1 or 2 times each in Colorado, Kansas, South Dakota, and New York and not at all in Oklahoma and Nebraska.

Race 38, although widely distributed, comprised only 2 percent of the isolates compared to 12 percent in 1954. It was most prevalent in Virginia but was found only occasionally in Kentucky, Michigan, North Carolina, Ohio, Pennsylvania, South Dakota, and Texas. The race 38-48 group decreased from 5 percent in 1954 to less than 1 percent in 1955. It was isolated twice from Idaho.

Race 48A, which can cause severe infection on Bowie and Travis wheats, was widely but irregularly distributed from the southeastern states northwestward to Ohio, Illinois, and Indiana. It was prevalent in Texas and was found occasionally in North Dakota, South Dakota, and Idaho.

Race 56, with 18 percent of the isolates, was widely distributed in 25 of 30 states. It was not found in California, Mississippi, New York, Washington, and West Virginia.

Race 11 was widely distributed in 9 states but comprised only 2 percent of the isolates. Some of the isolates of this race are known to be virulent on certain wheats. It appears to be endemic in California and has been found in the Sacramento Valley each year since 1952. This race was isolated from a collection of Kindred barley from Davis in 1955. In subsequent studies in the greenhouse at St. Paul, the isolate from Kindred produced an intermediate rust reaction (infection type X) which ranged from 0; to $4^{cn\ 6}$ on seedling plants of Kindred. This is the highest infection type observed so far on Kindred seedlings with any race to which it has been tested. Race 11 was also found in Idaho, and east of the Rocky Mountains it occurred in Illinois, North Dakota, Ohio, Texas, North Carolina, Virginia, and Florida. It was also isolated from barberry in Iowa, Illinois, and Virginia.

Race 139, which was prevalent in 1952-53, is still persisting by means of the barberry. Two isolates were identified in 1955 from aecial material and 1 on wheat near barberry in Virginia.

Special attempt was made to identify a considerable number of collections from barley and wild grasses, particularly in those areas where it is known that the wheat varieties are resistant to certain races. From 48 collections made in 1955 of barley and wild grasses, 62 isolates were identified, representing 10 races. Race 15B comprised 60 percent of the isolates; race 56, 18 percent; race 17-29 group, 10 percent; and there was 1 isolate each of races 11, 15, 36, 44, 48A, and 59. However, the relative percentages of races obtained in this way were not essentially different from those in the United States as a whole.

A number of rare or uncommon races were isolated from uredial collections made in barberry areas. Races 14, 23, 118, and 125 were identified from Virginia and races 81 and 186 from New York, all probably originating on barberry.

From 31 aecial collections from barberry in 7 states, 51 isolates comprised 25 races and biotypes, 18 of which were isolated only from or near barberry. The ratio of races to collections is 1:1.2 (Table 2). Four of the 25 races attack Vernal emmer.

During 1954 and 1955, special sets of varieties additional to the differential varieties were inoculated with selected samples of certain races that are difficult to identify on the standard differentials under all environmental conditions. This was done in an attempt to obtain more precise information on some of the group-race complexes and to obtain varieties useful as supplemental differentials.

Following is the list of supplemental varieties used in 1955:

1. Triticum timopheevi

2. Common wheats
   - Bowie (Tex. 3708-22)
   - Frontana x (K58-Nwth) II-50-17 (C.I. 13154)
   - Kenya 117A (C.I. 12568)
   - Kenya 117A (Australia 1347)
   - Kenya Farmer (C.I. 12880)
   - Khapstein (Australia 1451)
   - Lee x Mida Sib (NS 3880-227) (C.I. 13043)
   - Magnif Disro (Argentina, S.A.)
   - Magnif G (Argentina, S.A.)
   - Magnif MG (Argentina, S.A.)
   - N.D. 1 (Conley)
   - N.D. 3
   - Selkirk (C.I. 13100)

3. Durum wheats
   - Beladi 116 (Egypt)
   - C.I. 3255 (Spain)
   - Ld 364 (Yuma)
   - Ld 368 (C.I. 13164)
   - Ld 369 (Ramsey)
   - Ld 370 (Towner)
   - Ld 372 (Langdon)
   - R.L. 3206 (C.I. 13141)

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[6] 0; denotes hypersensitive necrotic flecks; cn indicates chlorosis and necrosis surrounding uredia.

R. L. 3207 (C.I. 13142)
Tremez Molle (Portugal) P.I. 56258-1

The following varieties differentiated several subraces within indicated groups: the 11-32 group, N.D. 3, Ramsey (Ld 369), and R.L. 3206; 15B, Kenya 117A (C.I. 12568), Magnif MG, R.L. 3206, and Yuma (Ld 364); the 17-29 groups, C.I. 3255, Magnif MG, Ramsey (Ld 369), R.L. 3206, and Tremez Molle; 48A, Magnif G and Magnif MG.

Puccinia graminis avenae

A total of 508 isolates of oat stem rust, comprising 7 races, were identified from 431 uredial collections (Table 3). Of these, the following were most prevalent: races 7, 8, 2, and 7A. Race 7 comprised 68 percent of the isolates; race 8, 12 percent; race 2, 12 percent; and race 7A, about 5 percent. The other races were found only occasionally. Twelve isolates of race 5 were identified from Missouri, Texas, and Virginia. The potentially dangerous race 6, hitherto associated closely with barberry in the northeastern states, was isolated once each from Missouri and Pennsylvania and twice from New York. Race 13, closely related to 6, was identified twice from Maine.

Race 2 was isolated twice from aecial collections in Virginia.

Race 7 increased in prevalence from 58 percent in 1954 to 68 percent in 1955. It was isolated from 25 states but not from California, Idaho, Tennessee, Florida, Maine, or New Hampshire.

Race 8 decreased from 17 percent in 1954 to 12 percent in 1955.

Race 7A decreased in prevalence from 9 percent in 1954 to 5 percent in 1955. It was found in 12 states from Oklahoma to Minnesota and westward to Montana. A few isolates were also identified from Georgia, Indiana, and Pennsylvania. This race is differentiated from race 7 on Rodney (R.L. 2123). At low or moderate temperature, Rodney is a good differential for 7 and 7A, but at temperatures above 80°F. the infection type produced by race 7 approaches that produced by 7A. Because of the high temperatures that prevail in the greenhouse during the summer months, the differentiation between 7 and 7A on Rodney is virtually impossible.

The identification of race 6 in an oat collection from Columbia, Missouri, is noteworthy, as this is the first time this race has been found independently of barberry in the Upper Mississippi Valley region. Race 6 was also identified at St. Paul from 2 varieties grown in the Uniform Rust Nursery at Winnipeg, Manitoba, in 1955. This may be an indication that the geographic range of race 6 has increased.

A variant of race 5, designated as 5A, was identified from rusted Saia oats adjacent to barberry at Blacksburg, Virginia. This isolate, which can attack Saia in the seedling stage, is noteworthy, as Saia had previously been resistant to all United States races to which it has been tested. Race 5A could not be differentiated from race 5 on the standard differentials and on 10 additional supplemental differentials. During 1954-55, Saia was used as a supplemental variety in the physiologic-race survey. It was resistant to all isolates identified and ranged in reaction from highly resistant to mesothetic.

Eleven varieties or lines of oats of the same or equivalent genetic origin as those used in 1954 were added to the 3 standard differential varieties in all identifications made in 1955. Saia was the only promising differential found among these varieties.

PLANT PEST CONTROL BRANCH AND FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, IN COOPERATION WITH THE MINNESOTA AGRICULTURAL EXPERIMENT STATION, ST. PAUL, MINNESOTA

Table 1. Physiologic races of Puccinia graminis tritici isolated from uredial collections in the United States in 1955.

State	Race and number of times isolated																												Total number of--		
	1*	11	14[a]	15	15B	21	23[a]	24	17-29	29	33*	35*	36*	38	38-48	44*	48A	56	59*	59A*	59B*	59C*	81[a]	118[a]	122	125[a]	139*	186[a]	Isolates	Races	Collections
California	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	1	3
Colorado	-	-	-	-	8	-	-	-	1	1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	13	4	10
Florida	-	1	-	-	-	-	-	-	4	2	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	11	4	9
Idaho	-	3	-	-	-	-	-	-	2	-	-	-	2	-	2	2	4	1	-	-	-	1	-	-	-	-	-	-	17	8	12
Illinois	-	1	-	-	30	-	-	-	3	2	-	-	-	-	-	-	2	16	-	-	-	-	-	-	-	-	-	-	54	6	39
Indiana	-	-	-	-	22	-	-	-	25	3	-	-	-	-	-	-	2	8	-	-	-	-	-	-	-	-	-	-	60	5	40
Iowa	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	15	2	13
Kansas	-	-	-	-	9	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	11	3	10
Kentucky	-	-	-	-	2	-	-	-	5	3	-	-	-	2	-	-	4	6	-	-	-	-	-	-	-	-	-	-	22	6	14
Michigan	-	-	-	-	11	-	-	-	8	2	-	-	-	1	-	-	1	3	-	-	-	-	-	-	-	1	-	-	27	7	14
Minnesota	-	-	-	-	33	-	-	-	5	3	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	44	4	35
Mississippi	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	2
Missouri	-	-	-	-	28	1	-	-	11	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	45	4	33
Montana	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	4	2	3
Nebraska	-	-	-	-	17	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	22	2	19
New York	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1	1	-	1	-	-	-	-	1	6	6	3
North Carolina	-	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-	8	-	-	-	-	-	-	-	-	-	-	14	4	13
North Dakota	-	1	-	1	56	-	-	-	3	2	-	-	-	-	-	-	1	8	-	-	-	-	-	-	-	-	-	-	72	7	64
Ohio	-	1	-	-	24	-	-	-	18	10	-	-	-	1	-	-	6	11	-	-	-	-	-	-	-	-	-	-	71	7	47
Oklahoma	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	12	2	10
Pennsylvania	-	-	-	-	4	-	-	-	4	2	-	-	-	2	-	-	-	7	1	-	-	-	-	-	-	-	-	-	20	6	13
South Carolina	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3	2	3
South Dakota	-	-	-	-	29	-	-	-	-	1	-	-	-	1	-	-	1	4	-	-	-	-	-	-	-	-	-	-	36	5	31
Tennessee	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	8	4	6
Texas	-	1	-	-	38	-	-	1	7	4	-	-	-	1	-	-	10	7	-	-	-	-	-	-	1	-	-	-	70	9	61
Virginia	-	3	3	-	6	-	1	-	-	4	1	-	-	6	-	1	2	16	4	4	-	1	-	1	-	1	1	-	55	16	42
Washington	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1
West Virginia	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	2	1	-	-	-	-	-	-	-	6	5	3
Wisconsin	-	-	-	1	10	-	-	-	5	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	17	4	11
Wyoming	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	14	2	10
Totals	1	16	3	2	356	1	1	1	106	44	2	1	2	16	2	3	35	138	7	7	2	2	1	1	1	2	1	1	755	28	574
Percentage of isolates	0.1	2.1	0.4	0.3	47.2	0.1	0.1	0.1	14.1	5.8	0.3	0.1	0.3	2.1	0.3	0.4	4.7	18.3	0.9	0.9	0.3	0.3	0.1	0.1	0.1	0.3	0.1	0.1			

*Races that were also isolated directly from aecial collections.

[a]There is evidence that these races originated on barberry in the locality where they were collected.

Table 2. Physiologic races of Puccinia graminis tritici isolated from aecial collections in the United States in 1955.

State	Race and number of times isolated																									Total number of		
	1	11	15	15B	17-29	19	21	24	33	34	35	36	44	48A	59	59A	59B	59C	69	111	116	117	139	147	177	Isolates	Races	Collections
Iowa	1	1	-	-	1	-	1	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	9	9	7
Illinois	-	2	-	-	1	-	-	-	-	-	1	1	-	-	-	-	1	-	-	1	-	-	-	-	-	7	6	3
Minnesota	-	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	1	-	1	-	-	5	5	4
Oregon	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	1	3	3	1
Pennsylvania	-	-	1	1	-	-	-	-	1	-	-	-	1	-	1	2	-	-	-	-	-	-	1	-	1	9	8	6
Virginia	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	1	2	-	2	-	-	-	-	1	-	9	6	4
Wisconsin	-	-	-	1	1	1	-	-	-	1	-	-	-	-	-	-	-	1	-	4	-	-	-	-	-	9	6	6
Totals	1	4	2	2	3	1	1	1	1	2	1	2	2	1	4	3	3	1	2	6	1	1	2	2	2	51	25	31
Percentage of isolates	2.0	7.8	3.9		5.9	2.0		2.0	2.0	3.9	2.0	3.9	2.0		7.8	5.9	2.0		3.9	11.6	2.0		3.9		3.9	100.0		

Table 3. Physiologic races of Puccinia graminis avenae isolated from uredial collections in the United States in 1955

State	Race and number of times isolated							Total number of		
	2	5	6	7	7A	8	13	Isolates	Races	Collections
Arkansas	1	-	-	1	-	-	-	2	2	1
California	1	-	-	-	-	-	-	1	1	1
Florida	1	-	-	-	-	5	-	6	2	5
Georgia	2	-	-	2	1	1	-	6	4	3
Idaho	1	-	-	-	-	-	-	1	1	1
Illinois	3	-	-	33	-	1	-	37	3	34
Indiana	1	-	-	13	1	-	-	15	3	14
Iowa	3	-	-	46	3	2	-	54	4	51
Kansas	4	-	-	8	1	-	-	13	3	11
Kentucky	2	-	-	11	-	-	-	13	2	11
Louisiana	2	-	-	1	-	-	-	3	2	2
Maine	-	-	-	-	-	1	2	3	2	2
Michigan	7	-	-	34	-	2	-	43	3	35
Minnesota	3	-	-	23	2	6	-	34	4	30
Mississippi	2	-	-	2	-	-	-	4	2	4
Missouri	3	1	1	12	3	6	-	26	6	22
Montana	-	-	-	4	1	3	-	8	3	4
Nebraska	-	-	-	2	1	1	-	4	3	4
New Hampshire	-	-	-	-	-	1	-	1	1	1
New York	-	-	2	12	-	1	-	15	3	12
North Dakota	5	-	-	21	5	15	-	46	4	33
Ohio	-	-	-	26	-	-	-	26	1	26
Oklahoma	3	-	-	10	1	-	-	14	3	11
Pennsylvania	-	-	1	17	2	1	-	21	4	18
South Carolina	2	-	-	1	-	-	-	3	2	2
South Dakota	3	-	-	21	2	4	-	30	4	25
Tennessee	1	-	-	-	-	-	-	1	1	1
Texas	8	8	-	12	-	-	-	28	3	24
Virginia	3[a]	3	-	3	-	-	-	9	3	8
Wisconsin	-	-	-	26	-	11	-	37	2	33
Wyoming	-	-	-	2	-	2	-	4	2	2
Total	61	12	4	343	23	63	2	508	7	431
Percentage of isolates	12.0	2.4	0.8	67.5	4.5	12.4	0.4	100.0		

[a] Isolated also from 2 aecial collections